

Indian Standard

(Reaffirmed 2013)

SPECIFICATION FOR ROTARY FORM-RELIEVED GEAR CUTTERS FOR SPUR AND HELICAL GEARS

1. Scope—Dimensions and requirements for rotary form-relieved gear cutters for milling spur and helical gears with modules 1 to 16 conforming to IS : 2535 - 1969 'Basic rack and modules of cylindrical gears for general engineering and heavy engineering (*first revision*)'.

1.1 Co-ordinates of points for drawing cutter profile are given in Appendix A

2. Terminology

2.1 Rotary form-Relieved Gear Cutter—A circular milling cutter having on its periphery teeth of such form that will cut-out a single tooth space in a gear blank.

2.2 Form Relief—The provision of a cutting clearance between cutter tooth and gear blank.

2.3 General terms relating to milling cutters and gears as given in IS : 1830-1971 'Technical supply conditions for milling cutters (*first revision*)' and IS : 2458-1965 'Glossary of terms for toothed gearing' respectively.

3. Cutter Groups

Group A — Set of 8 cutters

Group B — Set of 15 cutters

Cutter Number	Range of Teeth* for		Cutter Number	Range of Teeth* for	
	Set of 8 Cutters	Set of 15 Cutters		Set of 8 Cutters	Set of 15 Cutters
1	12 and 13	12	5	26 to 34	26 to 29
1 1/4	—	13	5 1/2	—	30 „ 14
2	14 to 16	14	6	35 to 54	35 „ 41
2 1/2	—	15 and 16	6 1/2	—	42 „ 54
3	17 to 20	17 and 18	7	55 to 134	55 „ 79
3 1/2	—	19 and 20	7 1/2	—	80 „ 134
4	21 to	21 and 22	8	135 to rack	135 to rack
4 1/2	—	23 to 25			

*Range of teeth are given for spur gears. For helical gears cutters shall be selected based on virtual number of teeth given as z sec 48.

where ???



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Gr 4

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AMENDMENT NO. 3 DECEMBER 1983
TO
IS : 5698-1970 SPECIFICATION FOR ROTARY FORM RELIEVED
GEAR CUTTERS FOR SPUR AND HELICAL GEARS

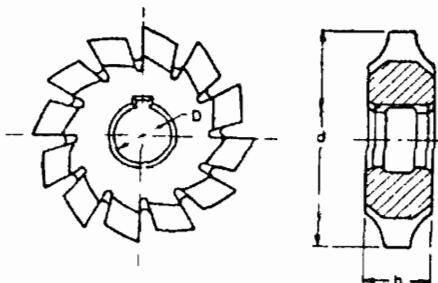
Alterations

(*Page 2, clause 4, Table*) — Substitute the table on page 2 for the existing table:

(*Page 7, Culler No. 6, column X, last entry*) — Substitute '**158.877**' for '**153.257**'

IS : 5698 - 1970

4. Dimensions



All dimensions in millimetres.

Module, <i>m</i>		<i>d</i> h16	<i>D</i> H17	<i>h</i> [*]	<i>n</i> [†]	Width <i>b</i> for Cutter Numbers															
Pre-ferred	Choice 2					1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8	
1	—	45	16	2 25	16	4 5	—	4 5	—	4	—	4	—	4	—	4	—	4	—	—	
T 25	1.125	45	16	2 53	16	4 5	—	4 5	—	4	—	4	—	4	—	4	—	4	—	—	
—	—	50	16	2 81	14	5	—	5	—	4.5	—	4.5	—	4.5	—	4.5	—	4.5	—	—	
—	1.375	50	16	3 09	14	5 5	—	5.5	—	5	—	5	—	5	—	5	—	4.5	—	4 5	
1 5	—	55	22	3 38	14	6	—	6	—	5 5	—	5 5	—	5 5	—	5	—	5	—	—	
—	—	55	22	3 94	14	7	—	6 5	—	6 5	—	6 5	—	6	—	6	—	5 5	—	5 5	
2	1 75	63	22	4 50	12	8	—	7 5	—	7 5	—	7	—	7	—	6.5	—	6.5	—	—	
—	—	63	22	5 06	12	8 5	—	8 5	—	8	—	8	—	7.5	—	7 5	—	7	—	—	
2.5	—	70	22	5 63	12	9 5	—	9 5	—	9	—	8 5	—	8.5	—	8	—	8	—	7.5	
—	—	70	22	4 19	12	10 5	—	10	—	10	—	9 5	—	9	—	9	—	8.5	—	—	
3	2 75	80	27	6 75	12	11 5	—	11	—	10 5	—	10 5	—	10	—	9.5	—	9.5	—	—	
—	—	80	27	7 31	12	12	—	12	—	11 5	—	11	—	10 5	—	10.5	—	10	—	9.5	
—	—	80	27	7 88	12	13	—	13	—	12 5	—	12	—	11 5	—	11	—	11	—	10.5	
—	3 5	80	27	8 44	12	14	—	13 5	—	13	—	12 5	—	12	—	12	—	11.5	—	11	
4	(3 75)	90	27	9 00	12	15	—	14 5	—	14	—	13 5	—	13	—	12.5	—	12	—	11 5	
—	—	90	27	10 13	12	16 5	—	16	—	15 5	—	15	—	14.5	—	14	—	13.5	—	13	
5	—	100	27	11 25	12	18	—	17 5	—	17	—	16 5	—	16	—	15.5	—	15	—	14 5	
—	—	100	27	12 38	12	20	—	19	—	18 5	—	18	—	17 5	—	17	—	16	—	15 5	
6	5 5	110	32	13 50	10	21 5	—	21	—	20	—	19 5	—	19	—	18	—	17.5	—	17	
—	—	110	32	14 63	10	23	—	22 5	—	21 5	—	21	—	20	—	19 5	—	19	—	18	
—	—	110	32	15 75	10	24 5	—	24	—	23	—	22	—	21 5	—	21	—	20	—	19 5	
8	7	125	32	18 00	10	28	—	27	—	26	—	25	—	24 5	—	24	—	23	—	22	
—	—	125	32	20 25	10	32	—	30	—	29	—	28	—	27	—	26	—	25	—	24	
10	9	140	40	22 50	10	34	—	33	—	32	—	31	—	30	—	29	—	28	—	27	
—	—	140	40	24 75	10	37	—	37	—	36	—	35	—	34	—	33	—	32	—	31	
—	—	140	40	27 00	10	41	—	40	—	39	—	38	—	37	—	36	—	35	—	34	
12	11	160	40	31 50	10	47	—	46	—	45	—	44	—	43	—	42	—	41	—	40	
—	—	160	40	36 00	10	53	—	52	—	51	—	50	—	49	—	48	—	47	—	46	

**h* indicates the working depth of profits.

†*n* gives the recommended number of teeth.

All dimensions in millimetres

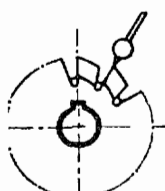
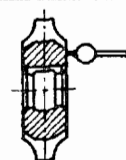
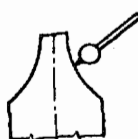
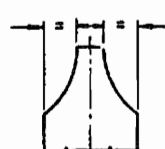
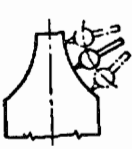
Moduli, <i>m</i>		<i>d</i> h16	<i>D</i> H7	<i>h</i> *	<i>n</i> †	Width <i>b</i> for Cutter Numbers															
Pre-ferred	Choice 2					t	t½	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8	
1		45	16	2 25	16	4 5	—	4 5		4	—	4	—	4	—	4		4		4	
1 25	1 125	45	16	2 53	16	4 5	—	4 5		4	—	4	—	4	—	4		4		4	
—	1 375	50	16	2 81	14	5	—	5	—	4 5	—	4 5	—	4 5	—	4 5		5	—	4 5	
—		50	16	3 09	14	5 5	—	5 5	—	5	—	5	—	5	—	5		4 5	—	4 5	
1 5	—	55	22	3 38	14	6	—	6	—	5 5	—	5 5	—	5 5	—	5		5	—	5	
2	1 75	55	22	3 94	14	7	—	6 5	—	6 5	—	6 5	—	6	—	6		5 5	—	5 5	
—	2 25	63	22	4 50	12	8	—	7 5	—	7 5	—	7	—	7	—	6 5		6 5	—	6	
—		63	22	5 06	12	9	—	8 5	—	8	—	8	—	7 5	—	7 5		7	—	7	
2 5	—	70	22	5 63	12	9 5	—	9 5	—	9	—	8 5	—	8 5	—	8		8	—	7 5	
—	2 75	70	22	6 19	12	10 5	—	10	—	10	—	9 5	—	9 5	—	9		8 5	—	8	
3	—	80	27	6 75	12	11 5	—	11	—	10 5	—	10 5	—	10	—	9 5		9 5	—	9	
—	(3 25)	80	27	7 31	12	12	—	12	—	11 5	—	11	—	10 5	—	10 5		10	—	9 5	
—		80	27	7 88	12	13	—	13	—	12 5	—	12	—	11 5	—	11		11	—	10 5	
—	(3 75)	80	27	8 44	12	14	—	13 5	—	13	—	12 5	—	12	—	12		11 5	—	11	
4	—	90	27	9 00	12	15	—	14 5	—	14	—	13 5	—	13	—	12 5		12	—	11 5	
—	4 5	90	27	10 13	12	16 5	—	16	—	15 5	—	15	—	14 5	—	14		13 5	—	13	
5	—	100	27	11 25	12	18	—	17 5	—	17	—	16 5	—	16	—	15 5		15	—	14 5	
—	5 5	100	27	12 38	12	20	—	19	—	18 5	—	18	—	17 5	—	17		16	—	15 5	
6	—	110	32	13 50	10	21 5	—	21	—	20	—	19 5	—	19	—	18		17 5	—	17	
—	(6 5)	110	32	14 63	10	23	—	22 5	—	21 5	—	21	—	20	—	19 5		19	—	18	
—		110	32	15 75	10	25	—	24	—	23	—	22	—	21 5	—	21		20	—	19 5	
8	—	125	32	18 00	10	28	—	27	—	26	—	25	—	24 5	—	24		23	—	22	
—	9	125	32	20 25	10	32	—	30	—	29	—	28	—	27	—	26		25	—	24	
10	—	140	40	22 50	10	35	—	33	—	32	—	31	—	30	—	29		28	—	27	
—		140	40	24 75	10	38	—	36	—	35	—	34	—	33	—	32		31	—	30	
12	—	160	40	27 00	10	42	—	40	—	39	—	37	—	36	—	35		34	—	33	
—	14	160	40	31 50	10	48	—	46	—	45	—	43	—	42	—	41		39	—	38	
18	—	180	50	36 00	10	55	—	52	—	51	—	49	—	48	—	47		45	—	44	

*Indicates the working depth of profile

† Gives the recommended number of teeth

5. Tolerance

5. Tolerance

SI No.	Elements to be Checked		Illustration	Tolerance in μm for Modules			
				Over 1 Up to 2	Over 2.5 Up to 5	Over 6 Up to 10	Over 10 Up to 16
1	Tolerance on radial position of tooth face, δ			$\pm 1^\circ$	$\pm 45'$	$\pm 30'$	$\pm 25'$
2.	Outside diameter			63	80	100	100
	Radial runout Between adjacent teeth			32	40	50	50
3.	Run out of face*			32	40	40	40
4.	Run out of side cutting edges of teeth†			63	80	100	100
5.	Symmetry of profile			200	250	320	320
6.	Profile error of cutting edge‡	Involute profile		50	63	80	80
		Tip of tooth and radii		100	125	160	160
*Faces shall be parallel to each other and square with axis. †Dial gauge normal to profile. ‡The profile of cutter teeth shall be checked with a template or with the aid of an optical projector.							

IS : 5698- 1970

6. Designation — A rotary form-relieved gear cutter for milling gears of module 4 and pressure angle 20°, made from high speed steel (HS) with cutter number 2 and of group A shall be designated as.

Rotary Gear Cutter m 4 × 20° × 2A IS : 5698 — HS.

7. Material

For one piece construction	High speed steel
For two piece construction	
a) Cutting portion	Hard alloy or hard metal
b) Body	Carbon steel of tensile strength not less than 70 kgf/mm ²

8. Hardness of Cutting Portion — 750 HV to 830 HV (62 HRC to 65 HRC)

9. General Requirements

9.1 Cutting face shall be radial

9.2 Dimensions for keyways according to IS : 1831-1961 'Dimensions for milling cutters'.

9.3 The cutters are intended for gears with tolerance Grade 9 conforming to IS : 3681-1966 'General plan for spur and helical gears'

10. Performance Test

10.1 Test Billet — Carbon steel C40 or C45 according to IS : 1570-1961 'Schedules for wrought steels for general engineering purposes'.

10.2 Method of Test — The cutters shall be tested on milling machines under the following conditions

a) Speeds, feeds and depth of cut shall conform to the values given below:

Module, m	Speed, m/min	Feed, mm/min	Depth of Cut
From 1 up to 3 Over 3 up to 6 Over 6	30 to 40	150 100 70	2.25 m

b) Cutting to the full depth shall be performed in one pass for a module up to and including 6 mm, in two passes for a module over 6 to 12 mm and in three passes for a module over 12 mm

c) The coolant used shall be sulphurized oil supplied continuously during the test.

d) The total length of the cut made by the cutter being tested shall be not less than the values specified below

Module	Length of Cut
	mm
From 1 up to 3	200
Over 3 up to 6	200
Over 6 up to 12	100
Over 12	65

e) After the test, the cutter shall have no visible signs of wear, crumbling-out or dents on the cutting edges and shall retain its cutting ability and be fit for further use

11. Marking — To be marked with module m, pressure angle α , cutter number, range of teeth, working depth h, material of cutter, and manufacturer's name or trade-mark.

12. Packing

12.1 Each gear cutter shall be covered with a suitable rust-proof coating and packed in a non-absorbent paper.

12.2 Each gear cutter or a number of gear cutters shall be wrapped in a non-absorbent paper protected by a cover bearing the designation for the cutter and the manufacturer's name or trade-mark.

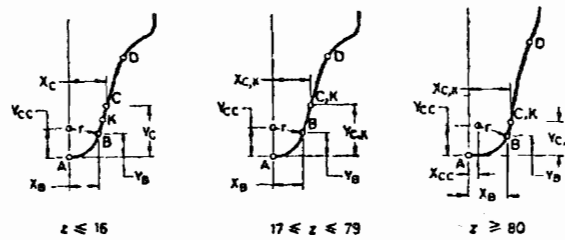
13. Certification Marking — Details available with the Bureau of Indian Standards.

*Since withdrawn

APPENDIX A

(Clause 1.1)

PROFILE OF CUTTER TOOTH



A-1. The co-ordinates of points on the non-involute part of the cutter tooth profile, with 100 mm module, 20° pressure angle and height of gear tooth dedendum $h_t = 1.25 m$ from point A to point C are given below:

Cutter No.	Number of Teeth, the Profile is Calculated for	Number of Teeth, the Profile is designed for	Co-ordinates of Point B		Co-ordinates of Point C		Co-ordinates of Circle Centre (cc)		Co-ordinates of Point (Addendum Circle)	
			X_B	Y_B	X_C	Y_C	X_{cc}	Y_{cc}	X_D	Y_D
1	12	12	63.724	58.393	66.590	91.100	0	63.968	151.021	208.515
1½	13	13	62.890	57.628	65.477	86.982	0	63.130	148.567	210.138
	14	14	62.197	56.993	64.435	83.122	0	62.434	146.395	211.491
2	15	15 and 16	61.563	56.412	63.594	79.382	0	61.798	144.519	212.624
2½	17	17 and 18	60.630	55.982	61.856	71.342	0	60.822	141.075	214.466
	19	19 and 20	59.218	53.339	60.570	66.245	0	59.542	138.854	215.779
4	21	21 and 22	58.013	51.294	59.358	62.149	0	58.458	136.967	216.814
4½	23	23 to 25	56.838	49.049	58.278	58.785	0	57.457	134.999	217.689
	26	26 to 29	55.938	48.162	56.785	53.794	0	56.565	132.941	218.673
5½	30	30 to 34	54.179	44.566	55.371	50.630	0	55.216	130.707	219.651
	35	35 to 41	52.916	42.551	53.861	46.851	0	54.178	128.873	220.521
6½	42	42 to 54	51.576	40.543	52.200	43.108	0	53.047	126.513	221.360
7	55	55 to 79	50.045	38.290	50.165	38.732	0	51.850	123.984	222.298
	80	80 to 134	48.030	34.377	—	—	1.848	48.210	121.473	223.199
8	135	135 and rack	45.955	30.461	—	—	4.007	44.114	119.115	223.966

A-2. The co-ordinates of points on the involute part of the cutter tooth profile, with 100 mm module m and 20° pressure angle from point C to point D and higher, are given below, the co-ordinates of point D being above the thick line.

Cutter No. 1		Cutter No. 1½		Cutter No. 2		Cutter No. 2½		Cutter No. 3		Cutter No. 3½	
Y	X	Y	X	Y	X	Y	X	Y	X	Y	X
91 100	66 590	84 982	65 477	83 122	64 495	79 382	43 594	71 342	61856	642 45	60 570
94 990	67 732	92 384	66 921	89 717	66 142	87 010	45 317	82 315	63 994	72 887	61 632
104 638	71 239	102 079	70 236	99 453	69 258	94 774	48 314	92 181	66 809	82 749	63 971
114 186	75 471	111 485	74 252	109 108	73 077	106 468	71 941	101 932	70 210	92 562	65 926
115 844	78 321	120 259	78 367	118 489	77 456	116 098	74 142	111 632	74 107	102 334	70 373
129 256	83 513	121 207	78 851	120 256	78 392	120 890	78 414	121 280	78 445	112 060	74 283
138 546	89 227	130 644	83 974	128 194	82 341	130 421	83 303	130 874	83 191	121 751	78 516
147 730	95 433	139 993	89 589	137 626	87 682	139 982	88 424	140 413	88 318	131 391	83 150
154 803	102 103	149 249	95 656	146 976	93 459	149 274	94 345	149 894	93 805	140 989	88 124
145 758	109 219	158 408	102 139	156 242	99 648	158 587	100 453	159 312	99 641	150 537	93 418
174 588	116 772	167 463	109 067	165 417	104 241	167 822	104 928	168 666	105 810	160 034	99 038
183 288	124 729	174 410	116 387	174 498	113 206	176 942	113 764	177 951	112 302	169 476	104 963
191 845	133 108	185 241	124 095	183 481	120 542	186 030	120 952	187 165	119 111	178 863	111 176
200 258	141 872	193 950	132 182	192 358	128 240	195 001	128 438	196 302	126 225	188 189	117 683
208 515	151 021	202 531	140 642	201 123	136 297	203 862	136 338	205 358	133 643	197 452	124 470
		210 138	148 567	209 772	144 694	212 625	144 515	214 425	141 348	206 649	131 527
214 609	160 554			211 491	146 395					215 779	138 854
224 533	170 449	210 933	149 465			221 276	153 024	223 311	149 344		
232 278	180 714	219 274	158 719	218 299	153 432	229 814	161 841	232 013	157 633	224 835	144 445
239 835	191 336	229 854	171 098	224 696	162 500	238 233	170 964	240 712	166 196	233 824	154 245
247 198	202 313	233 053	175 041	231 671	168 098	246 524	180 392	249 312	175 030	242 720	162 404
		238 592	182 078	238 228	175 736	254 489	190 124	257 900	184 142	251 540	170 769
		244 361	192 422	248 685	188 595	262 716	200 146				

(Continued)

Cutter No. 4		Cutter No. 4½		Cutter No. 5		Cutter No. 5½		Cutter No. 6		Cutter No. 6½	
Y	X	Y	X	Y	X	Y	X	YX		Y	X
62.149	59.358	58.785	58.278	53.794	56.785	50.630	55.371	46.851	53.861	43.108	52.200
68.163	60.426	63.399	59.052	63.609	58.706	53.902	56.043	54.082	55.542	44.317	52.496
78.043	62.682	73.296	61.227	73.503	61.148	63.818	58.354	63.999	58.121	54.253	55.038
87.885	65.495	83.158	63.917	83.375	63.998	73.717	61.000	73.907	60.960	64.180	57.861
97.691	68.763	92.992	67.041	93.221	67.198	83.598	63.989	83.799	64.060	74.096	60.854
107.461	72.448	102.796	70.542	103.044	70.721	93.461	67.267	93.679	67.402	84.004	64.078
117.197	76.473	112.570	74.400	112.844	74.557	103.305	70.815	103.543	70.970	93.900	67.468
122.052	78.521	122.314	78.546	122.618	78.646	113.132	74.612	113.394	74.752	103.786	71.059
126.897	80.852	132.026	83.010	132.367	83.016	122.956	78.657	123.228	78.732	113.660	74.774
136.559	85.545	141.704	87.756	142.087	87.641	132.721	82.932	133.046	82.915	123.523	78.741
146.179	90.552	151.347	92.775	151.780	92.517	142.484	87.424	142.846	87.296	133.373	82.839
155.753	95.848	160.954	98.058	161.440	97.670	152.223	92.130	152.627	91.856	143.210	87.091
165.292	101.436	170.518	103.614	171.069	102.958	161.938	97.046	162.392	96.610	153.035	91.496
174.780	107.284	180.043	109.413	180.667	108.486	171.629	102.176	172.134	101.515	162.842	96.062
184.218	113.404	189.525	115.453	190.223	114.307	181.292	107.500	181.858	106.618	172.636	100.779
193.604	119.787	198.961	121.736	199.747	120.308	190.927	113.018	191.558	111.875	182.415	105.641
202.937	126.425	208.343	128.318	209.230	126.516	200.533	118.726	201.238	117.307	192.178	110.648
212.213	133.312	217.689	134.999	218.673	132.941	210.109	124.619	210.891	122.909	201.923	115.803
216.771	136.851					219.651	130.707	220.521	128.673	211.649	121.093
										221.360	125.513
226.015	144.103	226.976	141.968	228.076	139.565	233.907	140.156	230.125	134.576	231.050	132.063
235.137	151.603	236.209	149.166	237.434	146.391	238.641	143.401	239.710	140.577	240.720	137.773
244.132	159.336	245.259	156.571	246.747	153.412	252.777	153.512	249.255	144.877	250.371	143.614
253.178	167.301							268.776	153.257	259.986	149.796
										274.405	158.753

(Continued)

Cutter No. 7		Cutter No. 7		Cutter No. 8	
Y	X	Y	X	Y	X
38.732	50.165	34.377	48.030	30.461	45.955
39.523	50.387	39.685	49.632	39.820	49.014
49.470	53.155	49.631	52.728	49.793	52.332
59.415	56.114	59.602	55.916	59.766	55.746
69.350	59.206	69.556	59.212	69.739	59.170
79.280	62.472	79.504	62.582	79.705	62.672
89.202	65.860	89.450	66.066	89.671	66.217
99.117	69.392	99.394	69.643	99.637	68.08
109.024	73.066	109.325	73.294	109.603	73.465
118.927	76.832	119.252	77.041		
123.875	78.798	124.220	78.943	124.534	79.029
128.815	80.782	134.145	82.834	129.514	80.918
138.698	84.827	144.062	86.801	139.472	84.745
148.571	89.005	153.976	90.844	149.417	88.583
158.438	93.295	163.885	94.965	159.369	92.500
168.292	97.708	173.785	99.148	169.314	96.455
178.135	102.242	183.681	103.502	179.258	100.455
187.973	106.877	193.570	107.863	189.203	104.535
197.794	111.636	203.454	112.324	199.140	108.627
207.404	116.536	213.328	116.854	209.070	112.764
217.405	121.467	223.199	121.473	219.001	116.974
222.298	123.984			223.966	119.115
		233.063	126.151		
232.083	129.130	242.919	130.929	238.852	125.554
246.728	137.130	252.760	135.770	253.734	132.075
271.080	150.726	267.525	143.172	278.514	143.217